

## **The Invention**

This invention relates to a polyisocyanate composition comprising a mixture of (1) a polyisocyanate and (2) a monomeric carbodiimide in an amount effective in improving the humidity resistance of the polyisocyanate. The polyisocyanate does not contain carbodiimide linkages. The monomeric carbodiimides have the structural formula:  $R_1-N=C=N-R_2$ . Since the compositions are a mixture, the polyisocyanate molecules do not contain carbodiimide linkages.

The invention also relates to the use of the polyisocyanate compositions in phenolic urethane binder systems curable with a catalytically effective amount of an amine curing catalyst. The foundry binder systems are preferably used to make molds and cores, preferably by the cold-box process, which involves curing the molds and cores with a gaseous tertiary amine. The cured molds and cores are used to cast ferrous and non ferrous metal parts.

The addition of the monomeric carbodiimide to the polyisocyanate component improves the shelf storage stability of the polyisocyanate by retarding an increase in viscosity and potential precipitation. The monomeric carbodiimide does not react with the polyisocyanate under ambient conditions. As a result, the binder can be effectively used without causing degradation of the tensile strengths of foundry shapes, e.g. cores and molds, made with the binder. The improved humidity resistance is particularly important during the hot summer months.

## **DISCUSSION OF EXAMINER'S OFFICE ACTION**

### **Claim Rejections - 35 USC § 112, second paragraph**

The following is a quotation of the second paragraph of 35 U.S.C. §112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the Applicants regards as their invention.

Claim 17 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. In claim 17, is "a round" a typo of --around--?

### **Applicants' response**

Claim 17 was amended to correct this mistake.

### **Claim Rejections - 35 USC § 103 (a)**

The following is a quotation of 35 U.S.C. §103(a), which forms the basis for all obviousness rejections Office action:

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wagner et al in view of Heitz et al.**

Wagner et al (col. 11, lines 42+) teach the claimed polyisocyanate composition which contains the claimed N,N'-carbodiimide groups and which is stable in storage, wherein the wt% of carbodiimide in the polyisocyanate composition (mixture) is 0.5 — 3. Wagner et al fail to teach the use of monomeric carbodiimide.

However, Heitz et al (col. 2, lines 51+) teach the use of monomeric carbodiimide for the purpose of enhancing the hydrolysis resistance of the composition. It would have been obvious to one having ordinary skill in the art to provide Wagner et al the use of monomeric carbodiimide as taught by Heitz et al in order to enhance the hydrolysis resistance of the composition.

### **Applicants' Response**

As the Examiner mentions, Wagner discloses polyisocyanate compositions having more than one carbodiimide group, but he says that Wagner fails to teach the use of monomeric carbodiimide.

There is a major difference between Wagner and the composition defined in claim 1 by Applicants. The polyisocyanate of Wagner has been modified, i.e. the polyisocyanate molecules contain carbodiimide linkages. The compositions claimed by Applicants are mixtures of polyisocyanate molecules that do not contain carbodiimide linkages and monomeric carbodiimides. The monomeric carbodiimide is added to the unmodified polyisocyanate to stabilize the polyisocyanate against humidity resistance. The gist of Wagner's teaching is found at column 2, lines 35:

It has now surprisingly been found that carbodiimidization catalysts may be bound to an insoluble high molecular weight inorganic or organic matrix via ionic bonds without substantial reduction of their catalytic

activity. High molecular weight, insoluble catalysts are thereby obtained which may be removed from the reaction mixture at any time so that it is now possible to convert monoisocyanates and, preferably, polyisocyanates into stable carbodiimides or polycarbodiimides which contain functional NCO-groups. It is also possible to produce stable mixtures of (poly) carbodiimides and polyisocyanates. One particularly surprising finding is that it is even possible to carry out selective carbodiimidization of certain monoisocyanates or polyisocyanates of an isocyanate mixture.

It is clear from this passage that Wagner does not teach adding a carbodiimide to a polyisocyanate to stabilize the polyisocyanate. His concern is with the preparation of polyisocyanates having carbodiimide linkages and the discovery of catalysts that can be used to control the reaction, which generates carbodiimide linkages in the polyisocyanate. In view of this, Applicants submit that Wagner does not teach or suggest their composition defined in claim 1, which relates to a stabilized mixture of polyisocyanate that does not contain carbodiimide linkages and a monomeric carbodiimide, rather than a polyisocyanate having carbodiimide linkages.

Heitz is less relevant than Wagner. Heitz also relates to prepolymers containing carbodiimide linkages, but the prepolymers are thermoplastic prepolymers rather than thermosetting prepolymers. Therefore, combining Heitz with Wagner does not teach or suggest the composition defined in claim 1.

**Claims 2-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wagner et al in view of Heitz et al and further in view of Shah.**

Wagner et al in view of Heitz et al fails to teach the use of diphenylmethylene diisocyanate (MDI). However, Shah (col. 5, lines 39+) teaches the use of diphenylmethylene diisocyanate

(MDI) for the purpose of meeting the mutual compatibility with carbodiimide and improving the mechanical property of the composition. It would have been obvious to one having ordinary skill in the art to provide Wagner et al in view of Heitz et al the use of diphenylmethylene diisocyanate (MDI) as taught Shah in order to meet the mutual compatibility with carbodiimide and improve the mechanical property of the composition.

#### **Applicants' response**

Applicants have already discussed Wagner and Heitz. Shah is no more relevant than Wagner Heitz. The only references Applicants could find to carbodiimides in Shah were at column 16, line 17, and in claims 5, 7, 19, 20, and 22. Again, all of these references related to a prepolymer of a liquid 4,4'- diphenylmethylene diisocyanate modified with carbodiimide linkages. The

compositions defined in claims 1-4 are not prepolymers, but are mixtures of an unmodified polyisocyanate and a monomeric carbodiimide.

**Claims 5-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Skoglund in view of Wagner et al and further in view of Heitz et al.**

Skoglund (col. 2, lines 25+) teaches a polyurethane-forming foundry binder system, comprising a phenolic resin component and a polyisocyanate component, where the polyisocyanate component contains an ortho ester. The invention also relates to foundry mixes prepared from the binder and an aggregate, as well as foundry shapes prepared by the no-bake and cold-box processes. The foundry shapes are used to make metal castings. Skoglund fails to teach the use of monomeric carbodiimide in the claimed polyisocyanate component.

However, Wagner et al in view of Heitz et al teach the claimed monomeric carbodiimide in the claimed polyisocyanate, the claimed N,N'-carbodiimide groups and the wt% of carbodiimide in the polyisocyanate composition (mixture) is 0.5-3 in paragraph 4 for the purpose of improving hydrolysis and mechanical property of polyisocyanate composition. It would have been obvious to one having ordinary skill in the art to provide Skoglund the use of monomeric carbodiimide as taught by Wagner et al and Heitz et al in order to enhance the hydrolysis resistance and mechanical property of the polyisocyanate composition, foundry binder system, foundry mixes and shapes.

#### **Applicants' response**

Skoglund is even less relevant because it does not mention polyisocyanates containing carbodiimide linkages, let alone mixtures of polyisocyanates that do not contain carbodiimide linkages and monomeric carbodiimides.

#### **CONCLUSION**

In view of the differences between Applicants' invention and the prior art, Applicants submit that their invention is not obvious. Furthermore, Applicants submit that their invention could only be derived from the references by the use of "hindsight", i.e. by knowing what Applicants' invention was in advance from Applicants' disclosure, and then *ex post facto* reconstructing Applicants' invention from the prior art after a thorough search. The prior art does not lead TPOSA to Applicants' invention. Applicants submit that the comments made by the Court in *AIR-vend, Inc. Throne Industries, Inc.*, 229 USPQ 505 at 515 (District Court, Minnesota, 1985) are appropriate here:

The question of obviousness, as the Court of Appeals for the Federal Circuit has acknowledged, is simple to ask, but difficult to answer... The difficulty in answering this question is due in no small part to the strong temptation to resort to and rely on hindsight in formulating the answer. Hindsight, however, is quite improper when resolving the question obviousness. To use the patent in suit as a guide through the prior art references, combining the right references in the right way to arrive at the result of the claims in the suit is, therefore, also

quite improper. Combining the teachings of the prior art to produce the claimed invention absent some teaching, suggestion or incentive supporting this combination cannot establish obviousness.

The Examiner knew, from Applicants' own disclosure, what Applicants' invention was when the patentability search was conducted. It is not easy to separate what the Examiner knew from the Applicants disclosure and what the prior art suggests. By the nature of the examination, the Examiner makes his determination of obviousness *ex post facto*. TPOSA does not have the advantage of knowing what the invention is, and must derive the invention from his insight as applied to the prior art. Applicants urge the Examiner to keep this in mind when deciding whether Applicants' invention is obvious. Applicants submit that it would take more than ordinary skill by TPOSA to derive Applicants' invention from the prior art at the time the invention was made.

Applicants submit that the application is now in condition for allowance and respectfully request a notice to this effect. If the Examiner believes further explanation of Applicants' position is needed, Applicants' attorney will discuss this matter over the telephone or visit the Examiner personally if this may be useful.

Respectfully submitted,



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